well's theory that the ultimate seat of electromagnetic and optical phenomena is in the æther may have to be modified or even abandoned. Experiments have proved that natural phenomena go on exactly as if there were no æther. We agree with the author in thinking that "the hypothesis that there is an æther may give a possible explanation of the phenomena, but the hypothesis that there is no æther provides an equally possible and very much simpler explanation." Einstein's theory, unfortunately, although it helps us to discover the laws according to which phenomena occur, cannot lay claim to provide a mechanical explanation of them. Electricians know the importance of discovering the mechanisms by means of which electric and magnetic forces are transmitted through space. When the nature of these mechanisms is discovered, there will probably be a great advance in the practical applications of electricity. The theory of relativity, a very convincing explanation of which is given in this book, proves that it is unnecessary to presuppose an æther. This is welcome, as it is known that highly complex properties must be ascribed to an æther in order that it may explain both electrical and magnetic forces. In the kinetic theory of gases, forces and pressures are explained by a flow of momentum, and a similar explanation might be given of electrical, magnetic, and gravitational forces.

From the practical electrician's point of view, the value of this volume would be increased if the ordinary working formulæ for the high-frequency resistance and inductance of cylindrical wires were given. Kelvin's electrostatic and hydro-kinetic analogies are useful in this connection. The engineer also wants the formula for the capacity between parallel cylindrical wires. The fact that a brush discharge begins at a perfectly definite value of the potential gradient is the principle on which accurate high-pressure voltmeters are constructed, and it is known that the sparking between spherical electrodes occurs at a definite potential gradient. Kelvin's formulæ for the attraction and repulsion of electrified spheres are proved, but no explanation is given of the column headed "Ratio of charges for equilibrium." We doubt whether the average reader would infer from this that spheres electrified with like charges would repel one another when far apart, and attract one another when close together. In conclusion, we can recommend this book to every student who has a sound mathematical training, and every man of science should read the new chapter on the theory of relativity.

A. R.

## Mathematical Text-books.

(1) *The Elements of Plane Geometry.* By Dr. C. Davison. Pp. viii + 280 (with answers). (Cambridge: At the University Press, 1920.) 10*s.* net.

(2) *A Primer of Trigonometry for Engineers: With Numerous Worked Practical Examples.* By W. G. Dunkley. Pp. viii + 171 (with answers). (London: Sir Isaac Pitman and Sons, Ltd., 1920.) 5*s.* net.

(3) *Pure Mathematics for Engineers.* By S. B. Gates. With an Introduction by H. A. Webb. Part i., pp. xi + 191. Part ii., pp. xi + 179. (The New Teaching Series.) (London: Hodder and Stoughton, Ltd., 1920.) 4*s.* 6*d.* net each vol.

(4) *A Second Course in Mathematics for Technical Students.* By P. J. Haler and A. H. Stuart. Pp. viii + 363. (London: W. B. Clive, University Tutorial Press, Ltd., 1920.) 6*s.*

(5) *Elementary Applied Mathematics: A Practical Course for General Students.* By Prof. W. P. Webber. Pp. ix + 115. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) 7*s.* 6*d.* net.

(6) *The Laws of Mechanics: A Supplementary Text-book.* By S. H. Stelfox. Pp. xi + 201. (London: Methuen and Co., Ltd., 1920.) 6*s.*

(7) *Elementary Dynamics: A Text-book for Engineers.* By J. W. Landon. Pp. viii + 246. (Cambridge: At the University Press, 1920.) 10*s.* 6*d.* net.

(1) THIS is a book in the old style, written by an old hand, and it has all the lucidity that we have learnt to expect of its author. The subject-matter is that of the first six books of Euclid, with the addition of some miscellaneous theorems on such subjects as concurrency and loci. The method and the arrangement are approximately those of Euclid, with some modern improvements. The book is the latest of its kind and probably the best.

The difficulties of a geometry of this type come mostly at the outset. When we went to school, in a less enlightened decade, we were taught that "a straight line lies evenly between its extreme points," and this elusive phrase, which seems to have a meaning, has haunted and mocked us ever since. Dr. Davison says (p. 1):—

> "A straight line is sometimes defined as a line which has the same direction from one extreme point to the other. The definition is, however, imperfect owing to the use of the word 'direction,'

to which no meaning has been given. The following definition is free from this objection.

> "*Def.* 1. A straight line is a line such that any part of it, however placed, may be made to lie upon any other part of it."

Alas! there are twenty-five words in this definition, and "no meaning has been given" to at least twenty-one of them. It is here that trouble lies for every beginner, and here lies also one reason why the modern teacher has taken to experimental geometry.

In a geometry which is essentially logical and metrical we should like to find the mechanism of measurement treated more fully. Dr. Davison does define "greater" and "less" in terms of "between" for segments of straight lines; but this is scarcely satisfactory for angles (p. 4), although thereafter the idea of magnitude is supposed to be sufficiently known. Again, in the subject of proportion incommensurables are given only a little paragraph in small type (p. 186). It is to be regretted that the author has not followed Prof. M. J. M. Hill in giving adequate treatment to this important notion.

(2) There is now a great host of books on mathematics for engineers, and most of them are bad. Here is a good book. Mr. Dunkley's programme is modest; it covers the ground as far as the solution of triangles. The main text is clear and sound, and it is incorporated with well-chosen examples of mechanisms which are fully worked out and illustrated with excellent diagrams. Each theme that is entered upon is followed through to the finish in a way that will give mental satisfaction to the student. Mr. Dunkley describes himself as a machine tool designer, and is apparently not a teacher.

(3) These two unhappy volumes are in contrast with the last. The author sets himself the task of covering the whole range of pure mathematics from the beginnings of algebra to volume integration, but it is difficult to see why the book is "for engineers," as there is scarcely a reference to engineering in the whole of it. The quality of the mathematics may be judged by a single citation (p. 97):—

> ". . . for a series to be convergent the following conditions must be satisfied. . . .
>
> "(3) The ratio of each term to the preceding must always be less than 1."

(4) This book is considerably better than the last. Much less ground is covered and there is a large collection of relevant exercises, which is the chief merit of the book. The text is not good. There is the tendency, familiar in such books, to introduce advanced subjects too early, *e.g.* infinite series on pp. 28–32 before simple equations. The treatment of the calculus is pedagogically unsound. Thus a differential coefficient is explained graphically as the slope of a graph (p. 150), but the authors say nothing about tangents until the foot of p. 154. When a tangent is at length introduced, it is explained as "the tangent to a circle which most closely coincides with the small portion of the graph on either side of the point." The introduction of differentials (p. 158 *seq.*) without any explanation is to be deprecated. It becomes unpardonably loose later on: "$dy = \frac{1}{3}(3x^2) = x^2$. Hence the integral of $x^2.dx$ is $\frac{1}{3}x^3$" (p. 181).

(5) "Applied mathematics" does not here mean mechanics. The book is written "to meet the needs of students who want some elementary mathematical training that they can use in everyday affairs." The chief need of American students appears to consist in having every problem turned inside out, and may be judged by the following typical exercise (p. 74):—

> "Sold cotton on 5% commission, invested the proceeds in sugar at 2% commission. My whole commission was $210. What was the price of the sugar and cotton?"

We do not need to work out such problems this side of the pond: we know the price of our sugar before we start; we find it easier.

There is, however, one thing in Prof. Webber's book that we do need, and do not often find in English books, and that is half a dozen pages on statistics.

(6) We like this book. The author calls it "a supplementary text-book," and makes no effort at completeness of exposition, but selects a number of subjects which are not often satisfactorily dealt with in ordinary text-books, and he dwells upon them at length. His style has the *naïveté* and freshness of first discovery, and there is nothing of that supercilious haste that one is accustomed to expect in a book designed for engineers. Although the author does not aim at completeness, he achieves nevertheless a certain continuity and unity. Among subjects that receive a chapter each are:—Dimensional arithmetic, calculus notation, the laws of equilibrium, and velocity diagrams. The last chapter contains an illuminating discussion of four or five examples of applied mechanics.

(7) Mr. Landon's book combines a text on more or less academic lines with well-selected examples from engineering as it is taught in colleges. The examples are clearly stated and neatly worked out, but somehow the author does not seem to dwell

upon them as if he liked them. A special feature is made of the treatment of the "laws of momentum," which replace Newton's laws of motion. This treatment is as follows:—After a cursory reference to mass on p. 2, two chapters are devoted to kinematics. In chap. iii., p. 57, momentum is defined. Then the "first law" appears (p. 58):—

> "In any body or system, the total momentum remains constant unless the body or system is acted upon by some external force. . . .
>
> "The first law introduces a new term, viz. force, which may, for the present, be defined thus:—
>
> "Force is that which produces or tends to produce a change of momentum.
>
> "The law is the result of observation."

We prefer Newton, but it is only fair to recognise that "laws" are always a difficulty in elementary mechanics, and on the whole we are inclined to recommend the book. H. B. H.

## Our Bookshelf.

*Animal Life in South Africa.* By S. H. Skaife. With an introduction by Prof. F. Clarke. Pp. x+281. (Cape Town: T. Maskew Miller; Oxford: Basil Blackwell, 1920.) 15*s*. net.

This book is intended to help teachers and pupils in South Africa to get to know some of the common animals of every grade. It is clearly written and abundantly illustrated with simple "thumbnail" sketches, many of which will enable the student to identify what he has seen. More critical sifting of the illustrations would have eliminated a number—*e.g.* that of Apus—which blur the total impression. It is almost impossible, except for men like Huxley, gifted with an unusual educational sense, to write a book useful for teachers and pupils alike, and though Mr. Skaife has done well, he sometimes falls between two stools—being sometimes too simple, sometimes a little difficult. There are also various statements requiring reconsideration, we think; thus we do not believe that the liver-fluke feeds partly on bile, and we are sure that a sea-urchin's teeth do not work up and down in their sheaths. But these are small matters; we mention them only as instances of a kind of defect that might easily be remedied, for the book as a whole is sound and careful, and it will be of great service. The chapters on insects, spiders, scorpions, and ticks are particularly good. We are interested to read that Peripatus may be fed on raw minced liver. "A female with twenty to thirty young ones clustering around her like chicks round a hen make a very pretty family party." Two educational remarks seem called for: (1) It is very doubtful whether we are warranted in using a word like "ugly" for such animals as the fishing-frog or Galeodes—it seems like undoing one of the endeavours of Nature-study, which is to show that no wholesome free-living wild creature can be called common or unclean. (2) Is there not more than once—*e.g.* in regard to flat worms and gapes-worms—a distinct and deplorable tendency to bowdlerise the elementary facts of sex? Because we appreciate Mr. Skaife's good workmanship, we would ask him to reconsider these points. The book appears to be extraordinarily dear.

*Anniversaries and Other Poems.* By Leonard Huxley. Pp. x+82. (London: John Murray, 1920.) 5*s*. net.

A book of dignified and melodious poems, in which it is interesting to observe the natural history touches—the child's poetic vision is compared to that of some under-water larval creature, glimpsing the sky, seeing "crooked tops to the tall, straight trees"; the full waves of the floral tide in a southern April, breaking on the hill "with white narcissus for their foam," are contrasted with the shyer coming in the north, with "less of fire and more of dew," and yet with its own exuberance, for

> bluebells thick in budding woods
> Stretch pool on pool from tree to tree,
> All heaven in their dew-drenched floods
> Of blue that mock your Midland sea.

Mr. Leonard Huxley is a lover of Nature, both of the great appeals and of the tiniest things that pass from sense to soul, from Nature's heart to man's. Common things are dear to him in themselves, not merely as emblems. Of the speedwell, "blue flower of happy name," he writes:—

> It buds on every fallow swell,
> And the bright wish it bids me frame
> Fills earth as music fills a shell.

Nature may or may not be fathomable, but surely it is still unfathomed, and we are among the heretics who think that of some of its depths not reached by the scientific dredge we get an inkling by the medium of disciplined feeling. Mr. Huxley makes his contribution, a perfectly clear-eyed one, and we do not agree more than a very little with the mood of the last poem, "The Land of Might-Have-Been," "portioned with felicity" though that mood be. The author has gone much further than that.

*Mechanism, Life, and Personality: An Examination of the Mechanistic Theory of Life and Mind.* By Dr. J. S. Haldane. Second edition. Pp. vii+152. (London: John Murray, 1921.) 6*s*. net.

The new edition of Dr. Haldane's little work is substantially the same, so far as subject-matter is concerned, as the first edition, which was reviewed in Nature for October 22, 1914. It is in the fourth lecture, on personality, that the main changes have been made. The whole chapter has been recast, and some additional matter inserted with the object of bringing home to the reader more certainly the meaning of this admittedly difficult subject.